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REPORT OF ACTIVITIES
J. M. STUCKEY
December 6, 1995 to February 5, 1996

I. ET LWT INSULATION

A. NCFI 24-124 FOAM (HCFC 141-B BLOWING AGENT)

1. All validation sprays for use on ET LWT have been completed, and has been applied to flight hardware on all three major areas on the ET (ET 85 LH_2 Tank in Sept. 95, ET 86 LOX Tank in Nov. 95, and ET88 Intertank in Dec. 95).

B. SS-1171 FOAM (HCFC 141-B BLOWING AGENT)

1. MAF is still working on completing all validation sprays. They did find that on longer duration sprays on simulated flight hardware that better results were obtained using the H-11 rather than the FF pumping system. Some 7 pumping systems are being modified for production sprays. KSC is now doing some practice sprays, and when they get around to doing the third hard point, they may encounter this same problem. If this happens, MAF may be able to send one of the seven systems they have modified to the Cape.

C. PDL-1034 FOAM (HCFC 141-B BLOWING AGENT)

1. Verification pours with this pour foam are either complete or essentially complete. It is my understanding that some practice pours are being done at KSC. The first application of this pour foam to flight hardware will possibly be done at KSC on ET-80.

II. ET SLWT INSULATION

A. NCFI 26-93 FOAM (LITE NCFI 24-124 FOAM WITH ADJUSTED FLAME RETARDANTS)

1. The present plans call for using NCFI 24-124 on the LOX Tank and Intertank, and possibly NCFI 26-93 on the LH_2 tank. The first lot of NCFI 26-93 was blended at MSFC; Lot #2 was blended at NCFI. Although the 2nd Lot may have slightly more blowing agent than Lot #1, it apparently gives a foam that has a somewhat higher density. Part of the lower density of Lot #1 was due to the reduction of about 0.5 of a knit line in the sample. It was sprayed at 2 rpm and a higher rise rate. This gives a foam with more waviness (undesirable) than foam sprayed at 3 rpm and a slower rise. Waviness tends to increase as the duration of the spray increased. If NCFI 24-124 is used on the barrel section of the LH_2 tank, it will give a calculated weight increase of 146 lbs. of insulation above the base line. Present data shows that the use of NCFI 26-93 for the insulation will reduce the calculated weight increase to 101 lbs.

2. To try to reduce the density of NCFI 26-93 foam, 1% additional HCFC 141-B blowing agent was added. Although no data was presented, it was orally stated that the foam was spongy and the appearance was poor.

3. Strength data on NCFI 24-124 foam and Lot #1 and Lot #2 of NCFI 26-93 foam all appear to be essentially the same, and meet requirements.

4. LMC proposed some changes to the agreed qualification programs for foams on the SLWT. They proposed to delete 3 of the 6 combined environmental tests, and the addition of 15 wide-panel tests. The MSFC group tended to agree with the elimination of 2 C/E panels, but was uncertain about 1 panel (may propose some changes). The MSFC employees were not certain about the wide panel testing and LMC could not present a clear picture of what was to be gained from the test. Some modifications are undoubtedly needed. As I see it, these tests could lead to requirements of NDE testing of all the ET foam.

5. A combined environment panel was tested that was more of a weld test than a TPS test although it was insulated with NCFI 24-124 foam. The test failed at 113% limit load while going to 125% limit load. The failure was in the parent Li/AL metal, and not in the weld. It was reported that no TPS failures occurred.

6. LMC is looking at possible places to reduce the foam insulation such as trimming or deleting the pal ramps. I suggested looking at the possibility of substituting NCFI 24-124 foam for NCFI 24-57 foam on the aft bulkhead of the LH_2 tank. This substitution would save about 60 to 80 lbs. of weight. The potential of this substitution can be determined by simple cheap thermal/vacuum tests. One 24" x 24" panel of NCFI 24-57, 24-124, and 26-93 would provide 4 test specimens for each foam. Recession rates for each foam could be determined from the thermal/vacuum tests that is a fair duplication of the exposure actually seen in flight.

This suggestion was made based on my observation that foam stability to heat is far more dependent on chemical structure than on density, and the chemical structure of all three foams are essentially the same.

III. THIRD GENERATION BLOWING AGENTS

A. PENTAFLUOROPROPANE BLOWING AGENT

1. LMC/MSFC sprayed some SS-1171 foam using pentafluoropropane HFC 245 fa and HFC 245 ca as blowing agent. The 245 fa boils at 58.5^0F and that for 245 ca at 77^0F. The density of the foam sprayed using HFC 245 fa is definitely heavier than that of the foam with HFC 245 ca indicating that the foam with HFC 245 fa probably lost more blowing agent during the spraying process. With the trimer foams I think the loss of blowing agent during the spraying process will be more severe. I believe the HFC blowing agent will be less soluble in the foam components, and probably will cause other problems such as adhesion to substrate. In my opinion foams blown with HFC blowing agent will also have reduced strain capabilities.

IV. LINER FOR COMPOSITE LOX TANK

A. PLASTIC FILM LINER

1. Some 1 mil Kapton H/0.5 mil FEP Teflon Film was obtained to see how well a liner for a composite tank can be made. It is proposed that the inner surface of the tank be FEP Teflon, and that composite tank be bonded to the Kapton H film surface. An experiment was tried bonding Kapton H film to FEP side of the composite film using a press. The cure of FEP Teflon bond was inevitably held for 1 to 2 hours at 670^0F and 20 psi instead of just 30 sec. We still had some bond to the Kapton film as evidenced by a simple peel test. This test sort of indicates that we may need a film consisting of 1 mil Kapton H and 1 mil of FEP Teflon.

In bonding this Kapton/FEP film together, we may run into the problem of bonding the liner to the substrate in the areas where the film is bonded together. This could be taken care of by perhaps using a TFE Teflon Film as a back-up in hopes that FEP Teflon film would not stick to TFE film. Another possibility would be to use a strip of thin aluminum foil as the back-up film and just leave it in place.

To really fabricate a liner, a hand held heated roller is needed that can be heating to at least 700^0F to 750^0F.

V. MISCELLANEOUS

A. THERMALLY SPRAYED ORGANIC COATING AS A PRIMER

1. Tim McKechnie showed a sample of a thermoplastic polyimide resin that he had thermally sprayed on stainless steel. The coating looked good and appeared to have good adhesion to the metal. Coating thickness appeared to be about 2 to 3 mils. Based on the appearance of the sample, he was asked to come up with a plan on what he might do to meet our requirements. Unfortunately, he has not presented a plan to us.

2. The sample of thermally plastic polyimide resin he used was part of the resin that had been obtained for our joint program at this center. He also has some of Langley thermoplastic polyimide resin that reportedly has a lower softening than that of the Furon resin we have. A lower softening might make it easier to process, but it also would lower the maximum use temperature. McKechnie may have a small contract with Langley to thermally spray some of their resin, but money problems must be present.

B. INSTAFOAM

1. This material is being used on the Solid Boosters. They are encountering trouble with ratio control. In the data they presented to us higher pressure was generally needed on the "B" side even to approach a 1:1 ratio. I believe that part of their problem is due to material separation, and the "A" & "B" components should be mixed prior to spraying.

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